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RAYON YARN AND STAPLE FIBER

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Foreign Economic Administration
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FOREWORD

This is one of a series of Special Industry Analyses discussing from a commodity or individual industry point of view the outstanding items entering into the trade of Japan proper with its Empire and with foreign countries. These analyses are a part of a larger project which includes compilations (annotated) of the imports and exports of Japan proper by sources and destinations; surveys of certain of the colonial areas, emphasizing their Empire and foreign trade and postwar problems relating thereto; an over-all study of the trade of Japan proper; and a survey of Japan's shipbuilding industry and shipping services and requirements in the prewar period. In all of the studies Manchuria has been included as an Empire area owing to the political, economic, and military dominance of Japan in that area, especially during the last decade.

Most of the data in these analyses were taken from official and semi-official Japanese sources. Not only have errors and inconsistencies frequently been detected within individual volumes, but many data from different sources frequently conflict. It is difficult to say in this. It is very likely that large shipments of goods reportedly moving to Kwantung from Japan have been in fact for shipments destined for Manchuria.

The present report is one of a number which were prepared during 1944 and 1945 for the Foreign Economic Administration by members of the staff of the United States Tariff Commission. Owing to the desire of the Foreign Economic Administration to obtain this material as rapidly as possible, the reports were not reviewed by the Tariff Commission. All statements of fact or opinion in these reports are attributable to the individual staff members who prepared them. The reports were originally intended for confidential use of Government agencies, but are now being made public with the consent of the Foreign Economic Administration.

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RAYON YARN AND STAPLE FIBER

Introduction and summary

The manufacture of rayon yarn in Japan was begun during World War I, and remained small throughout the first decade of its development. By 1928 the output of rayon yarn in Japan totaled 16.5 million pounds, or 5 percent of the world output. From sixth place in that year, Japan rose before the end of the following decade to the position of the world's largest rayon producing and exporting country. In 1937 its production of rayon yarn had reached about 335 million pounds, or 28 percent of the total world production.

Since 1937, staple fiber has constituted the major product of the rayon industry in Japan. Introduced in the early thirties, staple fiber has become of increasing importance to the Japanese as a substitute and alternative spinning fiber for imported cotton and wool. The production of Japanese staple fiber expanded from less than a million pounds in 1933 to 375 million pounds at its prewar maximum in 1938, when it constituted 39 percent of the world total.

Japan led the world as a producer of rayon (including both rayon yarn and rayon staple fiber) in the 3 years 1936-38. The combined production of rayon yarn and staple fiber in Japan reached its prewar record of 585 million pounds in 1938, or 30 percent of the aggregate rayon output of the world. In 1939 Japan was second to Germany and accounted for 24 percent of the total world production.

Rayon manufacture was one of the major large-scale enterprises of Japan in the prewar period. Requiring as it does a heavy capital investment, the production of rayon was limited to a relatively small number of large producers. The 34 companies in the Japanese rayon and staple fiber industry operated between 50 and 60 plants and had over 500,000 spinnerets in place. The productive capacity of the industry was greatly in excess of its actual production in the late thirties when the declining export demand forced a compulsory "sealing" of spinnerets and a reduction in operations of the industry to about one-third of its actual theoretical capacity.

Of the total production of rayon yarn and staple fiber which in 1939 amounted to about 550 million pounds with an estimated value of more than 400 million yen, about 16 percent was exported in unmanufactured form and about 20 percent (estimated) in the form of fabrics. The combined exports of rayon yarn and staple fiber, at their peak in 1939, amounted to 88 million pounds, valued at 64 million yen. In addition, it is estimated that about 114 million pounds of rayon yarn and staple fiber were utilized in that year in the manufacture of fabrics for export. The value of the rayon fabrics exported amounted in 1938 to 248 million yen or almost four times the value of the exports of rayon yarn and staple fiber. The aggregate value of the Japanese export trade in rayon products including rayon yarns, staple fiber, spun rayon yarn,^{1/} woven fabrics, and articles

1/ Yarn made from staple fiber.

manufactured of these materials amounted to 340 million yen in 1939, or about 6 percent of the total exports of all Japanese products to Empire and foreign areas. (See table 2.)

In 1938, when the combined exports of rayon yarn and staple fiber to foreign markets declined to the lowest level since 1934, the Empire areas, principally Korea, took about 35 percent of the total exports, both on a quantity and value basis. In 1939 exports to Empire areas declined to 20 percent of the total, as a result of the operation of the link system, which prohibited the exportation of rayon yarn and staple fiber manufactured from imported pulp, except to foreign countries.

Empire areas are of greater importance as a market for Japanese textiles manufactured of rayon and spun rayon than as a market for rayon in unmanufactured form. In 1939, the year of heaviest exports of rayon fabrics, shipments to the Empire countries (again chiefly Korea) amounted to about 130 million yen or 52 percent of the total trade. (See table 1.)

Japan, like all the leading rayon-producing countries, except the United States, is dependent on imports for the bulk of its cellulose pulp requirements for rayon manufacture. The other raw materials required in the chemical aspects of the rayon-manufacturing industry are for the most part available in Japan from domestic production. Japan is on a large import basis in salt, used in making caustic soda which in turn is necessary to rayon manufacture by the viscose process. The value of salt imports is, however, relatively small.^{1/}

Despite Japan's relatively weak position as a producer of rayon pulp, the exportation of rayon and its various manufactures from Japan created extremely large net credits in the international balance of payments of Japan.^{2/} (See table 2.)

1/ See Special Industry Analyses on Salt, and Soda Ash and Caustic Soda.

2/ While exports to Empire areas did not technically create credits for Japan, it is presumed that in the postwar period they would, were they to occur.

Table 2.- Rayon, rayon manufactures, and cellulose raw materials:
Estimated net export and import balance (in yen) of Japan, 1937-39

Item	1937	1938	1939
Net exports:			
Rayon (filament) and manufactures of:			
Rayon yarn	47,145	24,157	22,980
Fabrics of rayon yarn	183,454	160,834	145,671
Staple fiber and manufactures of: ^{1/}			
Staple fiber	7,967	185	31,126
Spun rayon yarn	7,408	10,673	12,112
Spun rayon fabrics	8,308	39,813	61,773
Manufactured articles: ^{1/}			
Wearing apparel and knit goods	11,649	11,218	13,324
Other manufactures	2,324	1,556	3,821
Total	268,255	246,880	340,873
Net imports:			
Wood pulp ^{2/}	79,860	34,244	48,842
Export balance	188,395	212,636	291,031

^{1/} Exports only; imports, not reported, probably were nil or negligible.

^{2/} Imports of wood pulp represent dissolving grades, a part of which is used also for munitions, plastics, and cellophane. In 1938 and 1939, about 75 percent of the volume of dissolving wood pulp imported was consumed in the production of rayon yarn and staple fiber for export either in the unmanufactured state or in the form of fabrics. Negligible exports listed as "cellulose pulp" are deducted from imports.

On the basis of the data at hand, the elimination of the rayon and staple fiber industry in Japan as a control measure does not appear justified. The manufacture of rayon and its products probably provided employment opportunities for nearly 200,000 workers, including those engaged in throwing and weaving. Japanese exports both of rayon yarn and rayon cloth have been important in supplying the textile needs of the Asiatic countries, including British India. With the cessation of imports from Japan, Asia would become dependent on European sources of supply, as neither India nor China has as yet developed a rayon yarn industry, and that in Korea is still in its developmental phase.

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In addition, the industry has supplied a large domestic market. The net amount of rayon yarn and staple fiber available for consumption in Japan itself in 1939 amounted to nearly 350 million pounds or 64 percent of the aggregate output. Over half of the rayon yarn and almost three-fourths of the staple fiber produced in Japan in that year were consumed in the home market for the requirements of the Japanese people. Japan was particularly dependent on rayon for its own needs in the immediate postwar period when the utilization of cotton and wool for domestic purposes became restricted in order to conserve foreign exchange. A general shortage of textile manufacture as a whole throughout the world is foreseen for a considerable period after the war, and the reduction of textile producing capacity in any one country will only further accentuate this shortage. To the extent that the postwar production in Japan of natural silk is lessened and the postwar imports of cotton and wool are reduced, the manufacture of rayon yarn and staple fiber will of necessity be important in meeting the future clothing needs of the Japanese population.

Probably the most important economic justification for the retention of production of rayon and staple fiber and their products in Japan is that the industry, unlike many others recently of importance in that country, is relatively well adapted to the economy of Japan from the standpoint of (chemical) raw materials, labor, and power. (The only exception is the industry's present dependence on foreign sources for its cellulose supply.)

The consequence of such a combination of favorable factors is that Japanese exports of rayon and staple fiber products create large net international credits for Japan. It is believed that the net credit obtained from rayon and staple fiber industry exports have been greater by far than the net credit obtained from exports of cotton and wool manufactures. In the postwar period Japan will be faced with an unprecedented situation, wherein its requirements of raw materials and finished goods to be imported will be far greater than its ability to pay from domestic resources. Encouragement, therefore, might logically be given to production for Japanese consumption and for export of those commodities, such as rayon, the manufacture of which is based in large degree on domestic raw material.

Whether Japan will be able to export rayon manufactures in the postwar period at the level reached before the war is questionable. With its advantage of low-labor costs, Japan might very well retain in the postwar period the cheap markets of the Orient against the competition of Italy and the Netherlands, the chief low-cost producers of Europe. Japan, presumably, would be in a position to renew its bid for the South American fabric market which it was beginning to penetrate before the war. If the United States tariff on staple fiber remains at its present low level of 25 percent ad valorem, Japan may attempt, unless restricted by quota arrangements or other regulatory measures, to regain its former

former position as a supplier of staple fiber to the American market. Japan is the leading source of staple fiber imports into the United States during the 5-year period 1935-39. In the latter year it accounted for 77 percent of the imports of staple fiber into the United States. The duty-paid unit price per pound of the Japanese staple fiber was considerably below that of the United States product.

As a result of the demand for rayon yarn in the military program, further expansion of staple fiber production in this country was held in bounds after 1942, when it reached 190 million pounds. Postwar plans, however, call for an increase in the manufacturing capacity of the staple fiber branch of the rayon industry to nearly 400 million pounds, with a target in 1950 and a per capita income at the level of that year, postwar imports of staple fiber into the United States might be in the neighborhood of 50 million pounds, more or slightly greater than in 1939. Japan might attempt to supply approximately one-fourth of the total estimated imports. Such an amount would be approximately equal to the maximum imports of staple fiber from Japan in 1939. (See also the study in this series, on rayon fabrics.)

Description

Rayon yarn and staple fiber are the two main products of the rayon industry; artificial straw and artificial horsehair are supplemental products. In many countries, including the United States, cellophane is also made by rayon companies but in Japan cellophane manufacture is a separate industry.

Rayon yarn is analogous to raw silk in that it consists of filament of continuous length held together with 2 or 3 turns twist per inch. It is numbered on the denier system used for silk.^{1/} The most common commercial sizes of rayon yarn in Japan are 120, 150, and 180 deniers; these yarn sizes have approximately between 30,000 and 44,000 yards of continuous filament per pound.

Whereas rayon yarn can be used directly by weavers and knitters in the form in which it is sold by the producer, staple fiber is a raw material which must be spun into yarn on cotton, wool, or spun silk spinning equipment. Staple fiber consists of short-length rayon filaments usually from $\frac{1}{2}$ to 6 inches long, corresponding to the staple of the various grades of raw cotton, wool, combed waste silk, and flax. The length and size of the staple fiber filaments depend on the spinning system on which the material is to be employed in the textile industry. Yarns composed wholly of staple fiber are called "spun rayon yarn" and are numbered in accordance with the system on which they are spun. Staple fiber is also suitable for blending with other textile fibers either in the raw stock state or in the carded or combed condition for the manufacture of mixture yarns.

^{1/} The weight in deniers (5 centigrams) of a skein 450 meters (492.13 yards) in length. The constant 4,454,523 divided by the denier will give the equivalent yards per pound.

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Uses

Continuous filament rayon and spun rayon yarn (i.e., yarn spun from staple fiber) are used mainly for weaving into broad and narrow fabrics for apparel and household purposes. Smaller quantities go into the manufacture of knit underwear, outerwear and hosiery.

Because of the shortage of raw wool and raw cotton during the war, Japan has made use of staple fiber as a blending medium in military apparel fabrics to stretch out the supply of the natural imported fibers. Before the war, Japan did not produce high tenacity continuous filament rayon but it is likely that it will undertake its manufacture as a substitute for cotton tire cord in heavy tire load and combat vehicle tires. In this country, high and medium tenacity rayon fiber has essential military uses in the manufacture of bullet-sealing hose and fuel cells and is also used for cargo, fire and fragmentation bomb parachutes. For the latter purpose Japan is said to draw on its large supply of silk.

Methods of production

Rayon yarn and staple fiber are made by converting cellulose, mainly sulphite wood pulp^{1/} into a viscous solution by chemical means and forcing the solution through capillary tubes, each of which has at its end a nozzle-like attachment called a spinneret. After extrusion through the sieve-like openings of the spinneret, the streams of liquid viscose are solidified into filaments in a chemical bath.^{2/}

The raw materials, the method of preparing the spinning solution, and the chemicals used are substantially the same, whether rayon yarn or staple fiber is the ultimate product. The point of departure is in the extrusion process (called spinning^{2/}) and in the subsequent treatment and handling of the filaments.

^{1/} Purified cotton linters are preferred for the acetate and carbon fiber processes; in this country, cotton linters are also used for mixing with sulphite wood pulp in producing high tenacity rayon yarn.

^{2/} In the acetate process the filaments are solidified by a process of evaporation in a heated chamber.

^{2/} The process of "spinning" as the term is used in the synthetic fiber producing industries, is wholly different from the spinning process employed in the cotton and wool industries. It actually refers only to the extrusion of the solution. The term is derived from the sericulture industry in which the silk worms emit a fluid in spinning their cocoons.

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Uses

Continuous filament rayon and spun rayon yarn (i.e., yarn spun from staple fiber) are used mainly for weaving into woven and non-woven fabrics for apparel and household purposes. Smaller quantities go into the manufacture of knit underwear, outerwear and hosiery.

Because of the shortage of raw wool and raw cotton during the war, Japan has made wide use of staple fiber as a blending medium in military apparel fabrics to stretch out the supply of the natural imported fibers. Before the war, Japan did not produce high tenacity continuous filament rayon yarn but it is likely that it has undertaken its manufacture as a substitute for cotton tire cord in heavy steel belts and combat vehicle tires. In this country, high and medium tenacity rayon also has essential military uses in the manufacture of bullet-sealing nose and fuel cells and is also used for cargo, fire and fragmentation bomb parachutes. For the latter purpose Japan is said to draw on its large supply of silk.

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^{1/} Purified cotton linters are preferred for the acetate and cuprammonium processes; in this country, cotton linters are also used for mixing with sulphite wood pulp in producing high tenacity rayon yarn.

^{2/} In the acetate process the filaments are solidified by a process of evaporation in a heated chamber.

^{2/} The process of "spinning" as the term is used in the synthetic fiber producing industries, is wholly different from the spinning process employed in the cotton and wool industries. It actually refers only to the extrusion of the solution. The term is derived from the sericulture industry in which the silk worms emit a fluid in spinning their cocoons.

Staple fiber manufacture is conducted with greater economy of capital, plant equipment, and labor than is rayon yarn. The manufacture of staple fiber is also much simpler and faster because of mass extrusion of the fiber. Each spinneret on the so-called spinning machine may have anywhere from 1,000 to 3,000 openings. In rayon yarn manufacture each spinneret is hardly larger in size than a thimble and produces merely the number of filaments required for a single yarn (usually 13-100 filaments depending on the size of the yarn). The group of filaments comprising each strand of yarn must then be twisted together and carefully handled as a single individual unit through all the subsequent finishing processes up to the point of packaging on cones or spools. In the case of staple fiber, on the other hand, the filaments from a large number of spinnerets are combined together to form a heavy rope or tow of several hundred thousand filaments.^{1/} The rope is then cut into short lengths to produce the rayon staple fiber of commerce.

Raw material requirements

The production of rayon in Japan is almost wholly by the viscose process. The cuprammonium process accounts for between 2 and 3 percent of the output and the acetate process about 1 percent. In the viscose method of manufacture, caustic soda and carbon disulphide are the main chemicals employed in the conversion of the cellulose into a spinning solution; in the precipitating bath, sulphuric acid, salts, and carbohydrates, such as glucose, are used. In the finishing treatments, the principal materials used are alkaline sulphites, bleaching agents, soaps, oils, and glycerin.

Estimates vary as to the amount of chemicals consumed per unit of yarn as much depends on the extent of recovery and the proportion re-cycled. The approximate amount of the most important chemical and cellulose raw materials required per pound of viscose rayon and the estimated minimum utilized in 1939 by the viscose branch of the rayon industry are as follows:

Raw material	Requirement : per pound of viscose rayon	Estimated total minimum volume required for out- put of rayon and staple fiber in Japan in 1939
	: Pounds	: Short tons
Sulphuric acid (96%)	: 1.6 to 1.8	: 439,000
Caustic soda (96%)	: 1.0 to 1.2	: 274,000
Carbon disulphide	: 0.35	: 95,000
Zinc sulphate	: 0.05 to 0.10	PURL: http://www.legal-tools.org/doc/cca94a/
Sodium sulphate	: 0.1 to 0.15	: 27,400
Sulphite wood pulp	: 1.2	: 329,000

^{1/} Because of the mass extrusion, the output of a staple-fiber spinneret is at least 10 times greater and often up to 30 times greater than that of a rayon-yarn spinneret.

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In most of its chemical requirements for the rayon industry, Japan is virtually self-sufficient, but before the war Japan had not succeeded in becoming independent of foreign sources for its supply of wood pulp for rayon. It was particularly deficient in the dissolving grades of wood pulp which it imported principally from the United States, Norway, Finland, Sweden and Canada. Manchuria was not a source for wood pulp of rayon grade until 1938 when imports from that country amounted to 14,000 short tons or 11 percent of the total imports in that year. During 1935-37, the total volume of rayon pulp imported into Japan averaged over 218,000 tons annually or about 80 percent of the total quantity available for consumption. In 1938 and 1939 imports were substantially smaller than in the 2 preceding years and were equivalent to 53 percent and 47 percent of the rayon pulp supply in the respective years. (See tables 11 and 12).

The decline in imports was the result of the inauguration in August 1938 of the link system of government control whereby purchases of foreign pulp were regulated in fixed proportion to Japanese exports of rayon and rayon textiles. The regulation was put into effect as one means of controlling the outflow of Japan's foreign exchange. The link system aimed to make pulp imports dependent on the export of yarns and textiles and thereby to provide the exchange for the purchase of raw materials from the proceeds of the sale of the finished manufactured goods. The link system on yarns became effective August 1, 1938, and on textiles October 1, 1938. Pulp imported under the link system was not permitted to be consumed for the manufacture of rayon for domestic consumption or for export to Empire areas.

Japan adopted a program for the production of 320,000 tons of rayon pulp from reeds, soybean and other vegetable fibers, the bulk of which was scheduled for manufacture in Manchuria. Available information, however, indicates that in no years prior to 1941 did the output in Manchuria exceed 50,000 tons.

Equipment requirements

Rayon plants are not especially well adapted for conversion to the production of munitions or other war potentials. The equipment in the chemical department which prepares the cellulose solution for both yarn and staple fiber is, however, essentially like that used in the chemical industry generally and comprises steeping presses (vats), hydraulic pressure pumps, shredders, mixers, settling tanks, xanthates (double jacket revolving drums or vacuum kneaders), filter presses, filtering centrifuges, air compressors, vacuum pumps and refrigerating machines. The chemical recovery equipment includes dialyzers, evaporating towers, crystallizers and other devices.

The spinning (extrusion) department, which is the heart of the plant, alone has specialized equipment unique to the industry. In Japan the bulk of the rayon yarn (probably 95 percent) is collected after extrusion in cake form on the centrifugal pot-type spinning machine which cannot be used for any other purpose. 1/

The equipment used in the last phase of rayon yarn finishing is of the general textile type and includes spoolers, twistlers, washing devices, hydro-extractors and dryers. For staple fiber, no spoolers and twistlers are necessary but cutting apparatus and bundling presses are required. In addition, rayon factories require steam and power plants, from the transformers, water softening and purification facilities and air conditioning and humidifying equipment.

Japanese river companies at first contracted with foreign engineering firms for factory plans and machinery but in the past decade many companies have installed equipment of Japanese manufacture for replacement and expansion.

Organization of the industry

Rayon manufacturing in Japan, as in other countries, is a large scale industry, requiring technical skill and large expenditures of capital. The Japanese rayon industry is confined to about 34 companies operating approximately 50 plants which are concentrated chiefly in the prefectures of Yamaguchi, Shiga, Hiroshima, and Okayama. The rayon industry is important around Lake Biwa in Shiga Prefecture close to the ports of Kobe and Osaka and the silk and rayon weaving centers which are concentrated in Fukui and Ishikawa.

Before the war, only 2 plants in Japan are reported to have made rayon filament yarns exclusively; 19 plants were primarily engaged in rayon yarn production and produced staple fiber as a side line; 9 plants made both rayon and staple fiber in substantial quantities, and 20 plants operated solely on staple fiber. 2/ Many of the latter war, yarn plants converted to staple fiber, but a number were also operated by new companies which built the plants specifically for staple fiber production. Some of the rayon yarn and staple fiber companies are subsidiaries of large spinning and weaving companies in the cotton and wool industries as well as of textile machinery manufacturers. Several of the rayon yarn producers

✓ All of the equipment is of the heavy type and PURD http://www.legal-tools.org/doc/cca94a/ corroding effect of the chemicals, such stainless steel must be employed. The steeping presses and shredders weigh in excess of 20,000 pounds each; a spinning (extrusion) machine with 100 spinnerets weighs from 30 to 40,000 pounds.

2/ Rayon manufacture requires 200 gallons of water per pound of output; rayon yarn and staple fiber require 2.5 and 2 pounds of coal respectively, per pound.

³⁵ From data in "Rayon Age," January 1940.

are associated with large reellers and wovens of rayon silk. A few of the large companies also have plants for the manufacture of chemicals^{1/} and maintain rayon pulp factories in Manchuria.

Several of the more important Japanese companies have established subsidiary rayon yarn plants in Korea. One company was also reported to have purchased an iron foundry and to have constructed a munitions or aircrafts parts plant within its own factory area.^{2/}

The rayon yarn industry in Japan had in 1939 a total of more than 500,000 spinnerets in place.^{3/} Three companies had between 50,000 and 65,000 spinnerets each and a daily capacity of between 80 and 100 metric tons; 4 companies had between 30,000 and 40,000 spinnerets; 5 companies between 20,000 and 30,000 spinnerets; 4 companies between 15,000 and 20,000 spinnerets, and 4 companies less than 15,000 spinnerets each. The spinnerets in place in staple fiber plants are not reported. Of the 54 companies in the industry, 21 operated on a single plant basis. One company operated 4 plants, 5 companies, 3 plants each, and 7 companies, 2 plants each.

The Japanese rayon industry has virtually no international tie-ups; only one company using the cuprammonium process was associated with a German producer in its organization. Most of the companies are members of the Japanese Rayon Association, which controls over 90 percent of the output. It operates as a cartel and with the approval of the government promulgates regulations for its members for restriction of production and limitation of installations of new equipment. It also apportions production quotas among its members.

Summary of production, imports, exports, and consumption

Marked expansion of production and exports of rayon yarns began in the mid-thirties and continued through 1937, after which both output and foreign trade declined below the level of 1935. During the period of expansion (1933-37), the exports of rayon in the form of yarn were considerably less than the volume which was exported in the form of manufactured woven fabrics. The estimated consumption of rayon yarn in the manufacture of export fabrics in those years was slightly over 100 million pounds as compared with direct exports of rayon yarn averaging less than half of that amount. Deducting the amount estimated to have been utilized for manufacture into woven fabrics for export, the supply of rayon yarn

1/ A number of rayon companies started in the mid-thirties to install their own plants for the manufacture of caustic soda because of the exorbitant price pegging by the domestic soda producers (Oriental Economist, May 1935, p. 19).

2/ U. S. Consular Dispatch, 1939.

3/ This compares with 343,000 on July 1, 1936. Despite the fact that which made curtailment measures necessary, the rayon industry continued to add to the installation of spinnerets.

4/ Equivalent to an annual capacity of between 65 and 80 million pounds.

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available for domestic purposes has averaged less than 50 percent of production since 1935. Before that time the bulk of the rayon production was consumed in the home market.

Staple fiber production, on the other hand, is largely for use within Japan. In 1937, over 80 percent of the staple fiber output was for home use; in 1939, 72 percent. Exports in the form of fiber were approximately equal to the volume exported in the form of finished fabric.

As compared with an annual average production of nearly 550 million pounds of rayon (yarn and staple fiber combined) in 1937-39, approximately 65 million pounds were exported in the unmanufactured form and an estimated 120 million pounds in the form of fabrics. The supply for home market consumption, therefore, probably averaged in that period about 365 million pounds or 66 percent of production. (See table 3.)

Production in Japan proper

Rayon manufacture became during the prewar decade one of the major industries of Japan. Production of rayon yarn, ^{1/} rose steadily to a peak of 334 million pounds in 1937 when it constituted about two-thirds of the output of the rayon industry. In the subsequent 3 year period, manufacture of rayon yarn fluctuated, averaging annually about 225 million pounds, or 43 percent of the aggregate products of the industry.

Staple fiber production, initiated in 1932, made rapid advances and surpassed that of rayon yarn in 1938. In that year the production of staple fiber attained its prewar maximum of 375 million pounds or 64 percent of the total production of unmanufactured rayon. Although a decline occurred in subsequent prewar years, staple fiber continued to be the principal product of the industry and represented between 55 and 60 percent of the aggregate rayon output. The production of rayon yarn and staple fiber is shown in table 4, and, for purposes of comparison, production in Japan and in other leading countries and the world is shown in table 5.

The value of the production of unmanufactured rayon is not reported. Estimated on the basis of the prices established under the Price Control Act, the output of rayon yarn in 1939 was probably valued in the neighborhood of 210 million yen and the output of staple fiber at more than 200 million yen.

^{1/} Approximately 72 percent of the output of 1939 consisted of 120 denier yarns; 15 percent, 150 denier yarn; 11 percent, 200 denier and coarser; and 1 percent 100 denier and finer. Specialties constitute an additional 1 percent. The coarser yarns, 150 deniers and over, were largely consumed in the manufacture of goods for domestic use; those finer than 150 deniers mainly in the manufacture of goods for export.

Table 5.—Rayon yarn and staple fiber: Production in Japan compared with output in other leading countries and the world, 1936-42

Kind and year	Japan		Germany		United States		Italy		Great Britain		World total	
	Million pounds	Per cent										
	:	:	:	:	:	:	:	:	:	:	:	:
Total rayon:	:	:	:	:	:	:	:	:	:	:	:	:
1936	320.8	24	192.8	15	289.9	22	196.1	15	143.0	11	1,321.9	
1937	508.6	28	344.2	19	341.9	19	262.9	15	152.4	8	1,819.2	
1938	584.6	30	470.0	24	287.5	15	268.3	14	138.2	7	1,945.9	
1939	548.8	24	620.0	27	379.9	17	310.0	14	180.0	8	2,227.5	
1940	525.0	22	825.0	35	471.2	20	525.0	14	150.0	6	2,380.8	
1942	700.0	20	1,100.0	32	622.6	18	452.0	12	135.0	4	3,472.9	
Rayon yarn:	:	:	:	:	:	:	:	:	:	:	:	
1936	275.0	27	99.0	10	277.6	27	86.0	8	116.8	11	1,023.3	
1937	334.3	28	125.0	10	321.7	27	106.5	9	119.7	10	1,200.0	
1938	209.6	21	140.0	14	357.6	26	101.4	10	106.5	12	988.3	
1939	239.3	21	171.0	15	328.6	29	119.0	14	120.0	11	1,145.5	
1940	225.0	20	250.0	22	390.1	34	100.0	9	100.0	9	1,144.0	
1942	300.0	21	220.0	15	479.3	33	132.0	9	90.0	6	1,447.2	
Staple fiber:	:	:	:	:	:	:	:	:	:	:	:	
1936	45.8	15	94.3	32	12.3	4	110.1	37	26.2	9	298.6	
1937	174.2	28	219.2	35	20.2	3	156.4	25	32.7	5	619.2	
1938	375.0	39	230.0	35	29.9	3	166.9	17	31.7	3	957.6	
1939	309.5	28	449.0	41	51.3	5	191.0	18	60.0	6	1,082.0	
1940	300.0	24	575.0	47	81.1	7	225.0	18	50.0	4	1,236.8	
1942	400.0	20	880.0	43	153.3	8	330.0	16	40.0	2	2,025.7	

Source: Textile Economics Bureau, Rayon Organization, June 1941.

Table 8.- Rayon yarn (artificial silk): Japanese exports, by principal markets, 1928-39

Year	All Countries	Empire Areas ^{1/}				Principal foreign countries					
		Kwantung	Manchuria	Korea	Total	British India ^{2/}	Mexico	China	Netherlands Indies	Australia	Other ^{3/}
Quantity (1,000 pounds)											
1928	67	2	4/	5/	2	2	-	6/ 56	7/	-	7
1929	154	1	4/	5/	1	-	-	6/ 149	1	1	2
1930	3,303	7/	4/	5/	124	24	4	5/ 3,129	3	10	9
1931	2,742	42	4/	1	187	229	163	5/ 1,878	1	371	100
1932	7,630	361	4/	1	277	639	2,125	94	3,440	8	1,057
Average, 1928-32	2,779	81	4/	196	199	463	19	1,730	3	288	77
1933	9,508	5,723	12	651	6,386	1,350	324	473	55	364	556
1934	23,403	8,186	4	1,190	9,380	8,448	1,532	943	301	46	2,753
1935	35,867	7,184	4	5,439	12,627	10,133	2,373	3,171	699	1,540	5,324
1936	47,939	13,037	123	3,640	16,800	14,112	3,757	2,940	1,264	1,631	7,435
1937	59,496	1,560	113	3,064	7,737	30,620	7,163	5,438	3,368	627	7,493
Average, 1933-37	35,243	7,138	51	2,797	9,986	12,943	3,030	2,593	1,137	842	4,712
1938	29,808	762	1,964	7,770	10,496	6,087	1,729	8,506	644	725	1,621
1939	40,819	333	5/	4,077	4,910	19,457	2,796	3,930	5/	1,372	8,854
Value (1,000 yen)											
1928	113	4	4/	5/	4	-	-	6/ 95	5/	-	13
1929	183	1	4/	5/	1	-	-	6/ 175	1	1	5
1930	3,357	9	4/	5/	121	130	20	3	6/ 3,179	4	18
1931	2,430	35	4/	5/	186	221	154	-	6/ 1,683	2	297
1932	6,177	324	2/	5/	267	591	1,556	81	2,833	9	866
Average, 1928-32	2,452	75	-	191	189	346	17	1,593	3	236	67
1933	10,121	6,476	11	638	7,125	1,356	250	442	51	313	586
1934	23,621	8,581	5	1,221	9,807	8,367	1,563	905	278	45	2,656
1935	27,140	5,626	4	4,287	9,917	7,593	1,686	2,293	477	1,181	3,993
1936	31,496	8,840	90	2,325	11,255	8,747	2,332	2,002	794	1,223	5,145
1937	47,290	1,328	97	2,487	3,912	23,154	6,018	4,629	2,730	518	6,329
Average, 1933-37	27,934	6,170	-	2,192	8,403	9,843	2,370	2,054	866	656	3,742
1938	24,190	672	1,766	6,302	8,740	4,550	1,150	7,487	473	550	1,240
1939	32,963	531	5/	3,635	4,166	14,163	2,069	4,370	5/	1,201	7,014

^{1/} Exclusive of negligible amount of "artificial silk thread" imported into Formosa from Japan in 1929 and 1930, which was reported in value only.^{2/} Includes Ceylon prior to 1934, and Burma prior to 1938.^{3/} Obtained by subtraction.^{4/} Included in China.^{5/} Not reported.^{6/} Includes Manchuria.^{7/} Less than 500.^{8/} Not available.

Source: Compiled from official annual and monthly statistics of foreign trade of Japan and Korea.

The decline in the total export trade in rayon yarn in 1938 to one-half of its previous volume was due in part to increased prices which were driven up by the threatened scarcity of raw materials. Japanese rayon prices rose rapidly in May and June 1938 despite large stocks and declining foreign demand. As prices of rayon in other producing countries, on the other hand, were undergoing very minor changes, Japan faced increased competition in Asiatic markets from the lower priced yarn of Italy and the Netherlands. Other factors also operated to depress exports to the far-eastern markets, chief of which were the boycotts and anti-Japanese sentiments in British India and China, the destruction of consuming mills in China and reduced purchasing power in these areas. Exports to the Empire areas also declined after mid-1938 when sales to these markets, which furnished no foreign exchange, were restricted by the Government. After the adoption of the link system whereby imports of pulp were made dependent on exports of rayon yarn to foreign countries, yarns intended for Empire markets could be manufactured only from the limited supply of domestic and Manchurian pulp. This further reduced the volume of yarn for export to Empire areas.

Exports of staple fiber from Japan in 1937, the first year for which such data are available, amounted to 14.8 million pounds valued at approximately 3 million yen. After declining 98 percent in 1938, exports of staple fiber again rose to almost 47 million pounds valued at 31 million yen in 1939. In that year exports of staple fiber were 15 percent greater in volume than exports of rayon yarn and were almost as large in value. Exports to the United States, the principal foreign market in 1937, amounted to over 70 percent of the total; those to China, 24 percent. Shipments to Korea, first reported in 1939, were approximately 30 percent of the total exports in that year. Other Empire areas were of negligible importance. (See table 9.)

Table 9.- Rayon staple fiber: Japanese exports of domestic product, by principal markets, 1937-39 1/

Year	Empire areas 2/				Other countries		
	All countries	Kwantung	Manchuria	Korea	United States	China	Other (by subtraction)
	Quantity (1,000 pounds)						
1937 --: 3/ 14,771	2	3	4	10,478	3,482	806	
1938 --: 3/ 291	10	116	4	5	141	19	-
1939 --: 46,761	5/	5/	13,768	5/	5/	5/	
	Value (1,000 yen)						
1937 --: 3/ 7,967	2	4	4	5,642	1,902	417	
1938 --: 3/ 185	9	85	4	3	80	8	
1939 --: 31,186	5/	5/	8,263	5/	5/	5/	

1/ Not separately reported prior to 1937.

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2/ Not separately classified in import statistics of Formosa or Mandated Islands.

3/ Exclusive of Korea, Formosa, and Mandated Islands for which data are not available. 4/ Not separately reported prior to 1939.

5/ Data by countries not available.

Source: Compiled from official annual and monthly foreign trade statistics of Japan and Korea.

The decline in the total export trade in rayon yarn in 1938 to one-half of its previous volume was due in part to increased prices which were driven up by the threatened scarcity of raw materials. Japanese rayon prices rose rapidly in May and June 1938 despite large stocks and declining foreign demand. As prices of rayon in other producing countries, on the other hand, were undergoing very minor changes, Japan faced increased competition in Asiatic markets from the lower priced yarn of Italy and the Netherlands. Other factors also operated to depress exports to the far-eastern markets, chief of which were the boycotts and anti-Japanese sentiments in British India and China, the destruction of consuming mills in China and reduced purchasing power in these areas. Exports to the Empire areas also declined after mid-1938 when sales to these markets, which furnished no foreign exchange, were restricted by the Government. After the adoption of the link system whereby imports of pulp were made dependent on exports of rayon yarn to foreign countries, yarns intended for Empire markets could be manufactured only from the limited supply of domestic and Manchurian pulp. This further reduced the volume of yarn for export to Empire areas.

Exports of staple fiber from Japan in 1937, the first year for which such data are available, amounted to 14.8 million pounds valued at approximately 3 million yen. After declining 98 percent in 1938, exports of staple fiber again rose to almost 47 million pounds valued at 31 million yen in 1939. In that year exports of staple fiber were 15 percent greater in volume than exports of rayon yarn and were almost as large in value. Exports to the United States, the principal foreign market in 1937, amounted to over 70 percent of the total; those to China, 24 percent. Shipments to Korea, first reported in 1939, were approximately 30 percent of the total exports in that year. Other Empire areas were of negligible importance. (See table 9.)

Table 9.- Rayon staple fiber: Japanese exports of domestic product, by principal markets, 1937-39 ^{1/}

Year	Empire areas ^{2/}				Other countries		
	All countries	Kwantung	Manchuria	Korea	United States	China	Other (by subtraction)
1937 --:	3/ 14,771	2	3	4/	10,478	3,482	806
1938 --:	3/ 291	10	116	4/	5	141	19
1939 --:	46,761	5/	5/	13,768	5/	5/	5/
	Value (1,000 yen)						
1937 --:	3/ 7,967	2	4	4/	5,642	1,902	417
1938 --:	3/ 185	9	85	4/	3	80	8
1939 --:	31,186	5/	5/	8,263	5/	5/	5/

^{1/} Not separately reported prior to 1937.

^{2/} Not separately classified in import statistics of Formosa or Mandated Islands.

^{3/} Exclusive of Korea, Formosa, and Mandated Islands. ^{4/} Not separately reported prior to 1939.

^{5/} Data by countries not available.

Source: Compiled from official annual and monthly foreign trade statistics of Japan and Korea.

Stocks

As a result of the reduction in foreign trade, large surpluses of domestic rayon yarn began accumulating in the latter part of 1937 in mills of the members of the Rayon Producers' Association and in warehouses at Tokyo, Osaka, and Fukui. Whereas the end-of-month stocks held in the earlier months of the year averaged around 12 million pounds, ^{1/} the stocks on hand at the end of the year were close to 40 million pounds. They steadily increased to a peak of about 57 million pounds in May 1938. The curtailment measures taken by the rayon industry did not succeed in lowering the stocks until operations were reduced to about one-third of capacity in mid-1938. Stocks in 1939 again approached the normal average level of about 11 million pounds per month. (See table 10.)

Table 10.- Japan: End-of-month stocks of rayon yarn,
July 1937-March 1940

Month	(In thousands of pounds)			
	1940	1939	1938	1937
January	15,747	6,493	47,245	:
February	17,747	9,559	52,302	:
March	18,961	8,775	52,797	:
April		11,441	55,431	:
May		11,290	56,589	:
June		12,665	48,206	:
July		12,083	37,965	18,354
August		12,188	32,611	21,936
September		11,741	23,166	21,648
October		12,409	20,514	27,612
November		14,357	19,194	34,962
December		14,659	13,430	37,741
Average (for months shown):	17,485	11,472	32,287	27,042
	:	:	:	:

^{1/} Described as stocks on hand in mills belonging to the Japan Rayon Producers' Association and in warehouses in Tokyo, Osaka, and Fukui. Does not include sealed stocks placed in cooperative storage or "invisible" stocks in consuming mills.

Source: Japan Rayon Producers' Association.

^{1/} The data are exclusive of sealed stocks held in cooperative storage and of invisible (unreported) stocks in consuming mills.

The decline in the total export trade in rayon yarn in 1938 to one-half of its previous volume was due in part to increased prices which were driven up by the threatened scarcity of raw materials. Japanese rayon prices rose rapidly in May and June 1938 despite large stocks and declining foreign demand. As prices of rayon in other producing countries, on the other hand, were undergoing very minor changes, Japan faced increased competition in Asiatic markets from the lower priced yarn of Italy and the Netherlands. Other factors also operated to depress exports to the far-eastern markets, chief of which were the boycotts and anti-Japanese sentiments in British India and China, the destruction of consuming mills in China and reduced purchasing power in these areas. Exports to the Empire areas also declined after mid-1938 when sales to these markets, which furnished no foreign exchange, were restricted by the Government. After the adoption of the link system whereby imports of pulp were made dependent on exports of rayon yarn to foreign countries, yarns intended for Empire markets could be manufactured only from the limited supply of domestic and Manchurian pulp. This further reduced the volume of yarn for export to Empire areas.

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Year	Empire areas 2/					Other countries		
	All countries		Kwantung	Manchuria	Korea	United States	China	Other (by subtraction)
	Quantity (1,000 pounds)							
1937	3/ 14,771	2	3	4/	10,478	3,482	806	
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1/ Not separately reported prior to 1937.

2/ Not separately classified in import statistics of Formosa or Mandated Islands.

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5/ Data by countries not available.

Source: Compiled from official annual and monthly foreign trade statistics of Japan and Korea.

Consumption of rayon in Japan

In 1923-37 over 55 percent of the rayon yarn retained for consumption within the country was utilized in the manufacture of fabrics for export. Using appropriate conversion factors, the rayon yarn content of the fabrics exported may be estimated to have averaged about 65 million pounds annually during 1933-37. The volume of rayon used by manufacturers weaving for export was therefore almost twice as much as the exports of yarn in unmanufactured form. About 37 percent of the rayon consumed in 1939 entered into the manufacture of fabrics for export but in three other recent years the ratio was nearly 50 percent. The net amount of rayon yarn available for consumption in the Japanese home market may be estimated to have averaged 117 million pounds in the 5-year period 1933-37 or more than three times the net consumption in 1928-32. After deducting for the yarn woven into export fabrics, Japan consumed for its own use, in the peak year 1937, probably in the neighborhood of 168 million pounds, or about 50 percent of its total rayon output. During the depressed year 1938, only slightly over half of this amount, or 87 million pounds (42 percent of production) was used for home consumption. In 1939, the supply for use by the Japanese themselves increased to approximately 126 million pounds or 52 percent of the volume produced. This expansion in home market consumption was the result of a decline in the demand for rayon for the export weaving industry. It was also stimulated by the relative scarcity of wool, the high price of silk, and the prohibition against the manufacture of cotton either in the form of yarns or textiles for domestic use.^{1/} Rayon yarn and staple fiber became, therefore, virtually the mainstay and bulwark of the domestic textile market.

The restrictions on cotton and wool consumption stimulated the expansion in the domestic use of staple fiber, which, at its maximum in 1938 probably exceeded 340 million pounds^{2/} or 91 percent of production. In the following year (1939) the expansion in exports of staple fiber both in unmanufactured form and in the form of fabrics reduced the net amount available for Japanese home consumption to 222 million pounds or 72 percent of the aggregate production. The Government promulgated measures which required the admixture of at least 10 percent by weight of staple fiber in the manufacture of woolen yarn and at least 20 percent in the manufacture of woolen cloth except in goods entering the export trade or in goods for which it was technically unsuitable.^{2/} In April 1938, the percentage of staple fiber to be used in the manufacture of domestic woolen yarns was raised to a minimum of 20 percent. Similar orders were issued by the Government for cotton manufactures. In February 1938, a mixture of 30 percent staple fiber in cotton yarn and cotton piece goods for domestic consumption was made compulsory. Late in the year^{3/} complete ban was placed on cotton for domestic use. In the middle of 1939, Manchuria drew up regulations for the admixture of staple fiber with cotton.

^{1/} U. S. Consular Dispatch, 1/32.

^{2/} Calculated by deducting estimated volume of staple fiber in manufacture of spun rayon fabrics for export.

^{3/} U. S. Consular Dispatch, 1/37.

Stocks

As a result of the reduction in foreign trade, large surpluses of domestic rayon yarn began accumulating in the latter part of 1937 in mills of the members of the Rayon Producers' Association and in warehouses at Tokyo, Osaka, and Fukui. Whereas the end-of-month stocks held in the earlier months of the year averaged around 12 million pounds, ^{1/} the stocks on hand at the end of the year were close to 40 million pounds. They steadily increased to a peak of about 57 million pounds in May 1938. The curtailment measures taken by the rayon industry did not succeed in lowering the stocks until operations were reduced to about one-third of capacity in mid-1938. Stocks in 1939 again approached the normal average level of about 11 million pounds per month. (See table 10.)

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June		12,665	48,206	:
July		12,083	37,965	18,354
August		12,188	32,611	21,936
September		11,741	23,166	21,648
October		12,409	20,514	27,812
November		14,357	19,194	34,962
December		14,659	13,430	37,741
Average (for months shown):	17,485	11,472	32,287	27,042
	:	:	:	:

^{1/} Described as stocks on hand in mills belonging to the Japan Rayon Producers' Association and in warehouses in Tokyo, Osaka, and Fukui. Does not include sealed stocks placed in cooperative storage or "invisible" stocks in consuming mills.

Source: Japan Rayon Producers' Association.

^{1/} The data are exclusive of sealed stocks held in cooperative storage and of invisible (unreported) stocks in consuming mills.

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FOREWORD

This is one of a series of Special Industry Analyses discussing from a commodity or individual industry viewpoint the outstanding items entering into the trade of Japan proper with its Empire and with foreign countries. These analyses are a part of a larger project which includes compilations (annotated) of the imports and exports of Japan proper by sources and destinations; surveys of certain of the colonial areas, emphasizing their Empire and foreign trade and postwar problems relating thereto; an over-all study of the trade of Japan proper; and a survey of Japan's shipbuilding industry and shipping services and requirements in the prewar period. In all of the studies Manchuria has been included as an Empire area owing to the political, economic, and military dominance of Japan in that area, especially during the last decade.

Most of the data in these analyses were taken from official and semi-official Japanese sources. Not only have errors and inconsistencies frequently been detected within individual volumes, but many data from different sources supposedly reporting on the same subject are irreconcilable. It is very likely that large shipments of goods reportedly moving to Kwantung from Japan have been in large part merely transshipments destined for Manchuria. In addition, the data probably exclude large shipments of commodities made to and from Empire areas for military purposes.

The present report is one of a number which were prepared during 1944 and 1945 for the Foreign Economic Administration by members of the staff of the United States Tariff Commission. Owing to the desire of the Foreign Economic Administration to obtain this material as promptly as possible, the reports were not reviewed by the Tariff Commission. All statements of fact or opinion in these reports are attributable to the individual staff members who prepared them. The reports were originally intended for confidential use of Government agencies, but are now being made public with the consent of the Foreign Economic Administration.

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BICYCLESIntroduction and summary

While in the United States bicycles are mostly used by young persons and adults for pleasure, in Europe and even more in Eastern countries, where incomes are lower and automobiles fewer, they are widely used as a means of transportation.

Various statistics and estimates indicate that before the war Great Britain, Germany, and Japan were the leading producers, with the United States closely following by 1936. Before that time the American, Swedish, and Dutch industries were comparable, and only a fraction of the size of the leaders.

Great Britain, Germany, and Japan were also the leading exporters. Exports from Japan increased from an average of 8 million yen in 1928-32 to 27 million yen in 1933-37. The largest markets for British bicycles were Africa, India, and Europe, for the German, Europe. Both exported substantially to South America, and to some extent to the Orient. Japan's principal markets were in the Far East; exports to Empire countries had increased steadily to 18 million yen in 1938. Exports from the United States have been small.

The bicycle industry is well adapted to the Japanese people and country. The requirements for raw materials are not large, the appropriate type of labor, not highly skilled, is abundant, and the shop equipment is simple and not of the type convertible to massive armament production.

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Owing to the methods used in reporting statistics of the Japanese industry, only very general estimates of production can be made. Using Japanese figures for value of production and exports, and estimates for the number and

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weight of bicycles, it appears that the annual prewar domestic production may have been roughly 1,000,000 bicycles, of which two-thirds were exported. The steel requirements for the domestic supply would, on this basis, be about 5,000 tons annually, and 10,000 tons for exports. This is not a large amount in relation to the probable postwar steel industry of Japan. Finished tires per million bicycles would weigh roughly only 1,500 tons; this would not present a serious problem, after normal world production of rubber is reached. If ball bearings are not to be made in Japan after the war, some would have to be imported for bicycles, they need not be of precision grade.

There are large bicycle markets at home and in the surrounding countries, which are not too exacting in their demands for high quality, and which call for low-priced bicycles. Before the war Japan competed in these export markets chiefly with Germany, to a lesser extent with Great Britain, and not at all with the United States. Japanese manufacturers, however, were making serious efforts to sell their bicycles in Western countries, and even in the United States. These efforts had been looked upon with some concern by the American industry. Before the war there were the beginnings of a bicycle industry in some of the Eastern markets mainly supplied by Japan.

If production in Japan were not permitted, the large demand for bicycles in Oriental countries and Malaysia would probably be partly supplied from Europe and possibly to some extent from the United States, but the higher prices asked by these suppliers would probably restrict consumption to some extent. It seems unlikely that the United States would obtain a substantial share of this market. It would seem that if a reasonable standard of quality were preserved, the low-priced labor of Japan and the negligible raw

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material import requirements indicate the advisability of a bicycle industry, supplying Japan and exporting to Oriental countries. In the United States, where a certain personal pride of possession might be attached to a bicycle, there might be a disposition to boycott bicycles of Japanese manufacture, but in Oriental export markets, such a disposition probably would not exist.

Table 1 gives a summary of Japanese production, imports, exports and consumption. All statistics are presented in value, as Japanese statistics for complete bicycles produced show only a small portion of the true total.

Table 1.- Bicycles and parts: Summary of production, imports, exports, and apparent consumption, Japan proper, 1928-39

(In millions of yen)

Year	Pro- duction	Imports	Exports			Apparent consumption	Percent ported
			To Empire areas	Other	Total		
1928	1/	.06	2/	5.20	2.19	7.39	3/
1929	18.73	.04	2/	5.41	3.04	8.45	10.32
1930	15.00	4/	2/	4.31	2.63	6.94	8.07
1931	15.75	4/	2/	3.74	3.10	6.84	8.91
1932	21.98	4/	4.88	5.53	10.41	11.57	47
Average, 1928-32	3/	.02	2/	4.70	3.31	8.01	3/
1933	28.77	5/	5.86	11.22	17.08	11.69	60
1934	37.00	5/	7.71	17.57	25.34	11.66	68
1935	41.15	5/	11.47	15.73	27.20	13.95	66
1936	49.25	3/	13.85	18.68	32.53	16.72	66
1937	53.87	3/	13.78	21.05	34.83	19.04	65
Average, 1933-37	42.00	3/	10.54	16.85	27.39	14.61	65
1938	53.06	3/	17.96	8.70	26.66	26.40	50
1939	3/	5/	1/	1/	6/26.28	3/	

1. Not separately reported.
Imports to Manchuria not included.

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2. Not available.

3. Less than 10,000 yen.

4. Less than 1,000 yen.

5. Not including exports to Formosa, Kwantung, or Manchuria.

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Production

In the United States and Europe it is common practice for a few firms to make frames and a few other parts, and buy the remainder from various makers. They then assemble and sell the complete machine. A very few firms make nearly all the parts. The same situation prevails in Japan. Most of the Japanese factories supplying the industry make only one or two parts, and employ only a few workers. Official statistics report that in 1938, 65 percent of the workers were in shops employing 5 or less, and only 4 percent in factories employing over 200 workers. Many of the small shops are of the household type, employing members of the family and perhaps one or two from outside. The work does not require long training, much of it is done by girls, and wages are very low.

Before the first world war production of bicycles in Japan was small; the industry was offered its first real opportunity when the war stopped imports from Europe and America. Technique was learned and a fair quality produced. The industry grew and export markets were developed, but much poor work came from the small shops, leading to complaints from purchasers. In 1931 the Japan Bicycle Manufacturers' Association was formed, and the next year, under Government auspices, it began to control production and marketing. It allocated production quotas among producers of bicycles and parts, fixed prices, and maintained an inspection system for sustaining quality, and controlled the number of permitted purchasers. The system is reported to have been successful in improving quality and maintaining price.

Production statistics are not entirely satisfactory. The number and value of complete bicycles produced is reported, but this is evidently only a small part of the actual production. The bulk of the output is reported as production of parts. Most of these are doubtless assembled and sold as complete machines, or exported, without appearing further in statistics.

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Estimates and statistics indicate an annual production of well over a million bicycles, perhaps as much as two million, comparable in a general way with that in the United States, Great Britain, and Germany.

In 1935 it was reported that 18,500 workers were employed in shops having more than 5 workers each. If it is true, as reported, that 65 percent of all workers were in shops employing 5 or less, this indicates a total employment of more than 50,000 persons in 1935.

Imports

Imports have been negligible since the Japanese industry became established. Trade returns show a decline from 1,681 bicycles imported in 1927 to less than 30 annually in recent years. Imports of parts, although not reported separately, are said by consular representatives to be inconsequential. Import duties restricted imports and assisted the domestic industry.

Exports

The first World War, shutting off exports from other parts of the world, left Japan almost the only supplier of far-eastern markets. After the war Europe resumed exports and limited Japanese foreign trade, but the devaluation of the yen in 1931 brought about a rapid increase in Japan's bicycle exports. In 1933-37 exports totalled about 27 million yen annually.

In 1929 the Japan Bicycle Exporters' Association was formed. In 1933 there was a great increase in exports to Eastern markets, but domestic competition led to undue lowering of prices and quality. The association undertook to remedy this condition, and in 1934 effected agreements among its members, fixing prices and export quotas for each. But nonmembers continued their former practices, which led to financial losses and complaints of low quality from purchasers. In 1936, therefore, the Government announced that

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all exporters must observe the Association's rules in respect to inspection for assuring proper quality, prices, and export quotas.

Export trade reached its peak in 1937 when it was valued at 35 million yen. After that year several factors began to depress foreign sales. The war in China lessened exports to that market, which had been second only to Korea in importance. German competition became more severe in many regions. There were complaints from purchasers of careless packing and inferior quality. By 1938, according to official statistics, exports to non-Empire countries had fallen to four-tenths (9 million yen) of the value of the previous year. This was not serious for the industry, as exports to Empire countries (18 million yen) more than offset the loss. But the Government was anxious to increase the flow of foreign funds, and again stepped in. Several remedies seem to have been applied: Allocations of metal to the industry were increased, prices of necessary materials were reduced, inspection fees were much lowered, more careful inspection was enforced, and a new export association was formed to handle all purchases of material for exporters. These measures were especially and sometimes wholly applied in connection with bicycles for export to foreign currency countries. The effect of these steps is obscure, as no export statistics were published after 1938. Furthermore, a large part of the bicycle shops were converted to production of military supplies.

Table 2 shows exports by countries.